

MONTHLY WEATHER REVIEW,

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WAR DEPARTMENT,

Office of the Chief Signal Officer,

DIVISION OF

TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.

INTRODUCTION.

In compiling the present REVIEW the following data, received up to January 14th, have been made use of, viz: the regular tri-daily weather charts, containing the data of simultaneous observations taken at 119 Signal Service stations and 11 Canadian stations, as telegraphed to this office; monthly journals and means, 109 and 143 respectively, from the former, and monthly means from 13 of the latter; reports from 26 special Sunset stations; 237 monthly registers from Voluntary Observers; 34 monthly registers from United States Army Post Surgeons; Marine Records; International Simultaneous Observations; monthly reports from Voluntary Observers and the local Weather Services of the States of Iowa and Missouri; reliable newspaper extracts; special reports.

BAROMETRIC PRESSURE.

Upon chart No. II is exhibited by the isobaric lines the general distribution of the atmospheric pressure, as reduced to sea-level, for the month. Compared with the means for December of previous years, the pressure has generally been below the normal, east of the Mississippi; the greatest deficiency (0.05 to 0.11 in.) occurring over the Lower Lake region, Middle States and New England. West of the Mississippi the pressure has generally been above the normal, the greatest excess (about 0.17 in.) occurring in Oregon.

The Local Barometric Ranges for the month, as reduced to sea-level, have been largest over the Middle States and New England and least from the Rocky Mountains to California. Taken by districts, they vary as follows: New England, 1.25 in. on summit of Mt. Washington and 1.43 at Eastport to 1.70 at Burlington; Middle Atlantic States, 1.65 at Atlantic City and Norfolk to 1.90 at Fort Whipple; South Atlantic States, 0.96 at Jacksonville to 1.44 at Charlotte, N. C.; Lake region, 1.78 at Rochester to 0.97 at Marquette; Ohio valley and Tennessee, 1.53 at Pittsburgh to 0.94 at Memphis; Gulf States, 0.99 at Mobile to 0.76 at Vicksburg and Laredo, Tex., and 0.52 at Key West; the Northwest and eastern slope of Rocky Mountains, 1.00 at St. Louis to 1.40 at Pembina, 1.47 at Dodge City and 1.19 at Fort Sill; Rocky Mountains, 0.47 at Santa Fé to 0.64 at Denver; Western Plateau, 0.64 at Salt Lake City to 0.70 at Winnemucca; California, 0.70 at Red Bluff to 0.81 at Visalia.

Areas of High Barometer.—As usual, for this month, the areas of high pressure have been well marked, and have exhibited a decided influence on the climate of the country. Nine areas merit a brief description. Two (Nos. V and VI) have been remarkable for the persistence shown in remaining on the Pacific coast. Special attention is also called to Nos. II, V, VII, and IX, which, after entering the Gulf States, were accompanied, or rather followed, by storms which probably developed in that vicinity after the cold winds of the high area had begun to blow over the warm and moist surface of the Gulf of Mexico.

No. I.—is a continuation of high area No. IX, described in the November REVIEW. 1st, 7:35 a. m., it extended over New England and the St. Lawrence valley; that day it moved beyond Nova Scotia, with winds veering to southeast in advance of low area No. I, then entering the Lake region.

No. II.—4th, the pressure rose slowly in Texas, while clear weather, with light northerly winds, prevailed in the Gulf States. 5th, the rise extended over the East Gulf and South Atlantic States, but the barometer fell slowly in the Southwest, where the winds veered to warmer southeast in advance of the development in Texas of a storm-centre, charted as low area No. III. 6th, slowly diminishing, the high area was transferred to the Florida region.

No. III.—5th, the barometer rose rapidly in Manitoba. 6th, the rise extended over the Northwest, where it was accompanied by light snows, followed by colder, clearing weather and northwest winds. 7th, the high area moved to the southeast, with maximum pressure central in Virginia. 8th, it was transferred to the Middle Atlantic and New England coast. 9th and 10th, the high barometer, slightly increasing in pressure, moved slowly to Nova Scotia and thence to the Cape Breton region, where it disappeared, with winds veering to southeast in advance of the great storm of the 9th, 10th and 11th, (low area No. III.)

No. IV.—6th, the mercury rose on the Pacific slope. 7th and 8th, an examination of the charts of departures from normal pressures, shows that the high area spread over New Mexico and Arizona. It is interesting to note in connection with this area that it was situated to the northwest of storm-centre (low area No. III) then developing in Texas, while the high area just described (No. III) was situated in the Middle States and New England. These two high areas, 1,500 to 2,000 miles apart, gave rise to a circulation of winds around the centre of depression in Texas favorable to the development of the great energy that storm afterwards displayed.

No. V.—10th, the pressure rose rapidly on the north Pacific coast. 11th, continuing highest in Washington Territory, the barometer rose over all the United States, the greatest rise occurring in the Middle States. 12th, the pressure increased all over the chart, while the highest area extended from Washington Territory to Manitoba and Minnesota. 13th, 14th and 15th, the pressure was above the mean west of the Mississippi, remaining highest on the Pacific coast, but rising only from Southern California to Louisiana. 16th, the area of highest barometer was this day transferred to Manitoba and Minnesota, but over the entire map the pressure was generally above the mean. 17th and 18th, the high area extended from the Northwest to the Gulf States, Tennessee and the Ohio valley. 19th, the isobar of high barometer 30.50 included the country from the Lower Mississippi valley to the Middle and South Atlantic coast. This day a storm of considerable energy was developing in the Southwest, one of less intensity in the Northwest. 20th, diminishing in pressure, the highest area was transferred to the Middle States and New England. 21st, it moved in a northeasterly track beyond Nova Scotia, accompanied by cold northwest winds veering to warmer southeast in advance of storm-centre (No. VI) then entering the Lake region. This high area is remarkable for the large extent of country covered by its isobars of high barometer in its passage from the Pacific to the Atlantic.

No. VI.—This is a continuation on the Pacific coast of the high area (No. V) just described, which on the 16th was transferred east of the Rocky Mountains; but although the maximum pressure had moved to the eastward, still the barometer had remained above the mean in Washington Ty. and Oregon, and the mercury began on the 17th to rise again. 18th, 19th and 20th, the high area remained nearly stationary, generally occupying the region west of the Rocky Mountains. 21st, the pressure remaining highest in Idaho, the barometer generally rose west of the Mississippi river. 22nd, the high area slowly diminishing was transferred to Washington Ty. and Oregon. 23rd, 24th, 25th, 26th and 27th it remained nearly stationary in position. 28th and 29th, it disappeared in advance of a great depression entering the Pacific States from the southwest. This high barometer was remarkable for the persistence it exhibited in remaining over Washington Ty. and Oregon. Its great influence on the climate of that region is shown by a comparison of the means for this month with the same month of previous years. Temperature $1^{\circ}.5$ below the mean. Rain-fall $3\frac{1}{2}$ inches deficiency; barometer 0.17 above the mean.

No. VII.—20th, at the midnight report a region of low barometer extended from the Gulf to the north of Lake Superior (low area Nos. VI., VII.). 21st, the mercury rose rapidly west of the Mississippi river. 22nd, the highest area moved into the Gulf States. 23rd, rapidly diminishing in pressure, it moved eastward beyond the Atlantic coast, in advance of the storm-centre developing in the Gulf (No. VIII.).

No. VIII.—23rd, barometer rose very rapidly in the Northwest. 24th, highest pressure 0.5 inches above the mean was transferred to the Indian Territory. 25th, the high area spread over Tennessee and the Ohio valley. 26th, it disappeared in advance of the storm-centre No. VII., then moving over the East Gulf and South Atlantic States. Considered in connection with the snow areas that preceded (Nos. VI. VII.) it was accompanied by high westerly gales and extraordinary snow-storms over the Lakes and adjoining country. The following maximum velocities are reported: Duluth, 30, NW.; Milwaukee, 45, W.; Grand Haven, 50, NW.; Alpena, 26, W. In the Lower Lakes the maximum velocities reported generally exceed 30 miles, but at Buffalo a maximum velocity of 72, W., occurred during a heavy snow-storm. The minimum temperatures of the month, except in the East Gulf and South Atlantic States, occurred during the regime of this high area.

No. IX.—26th, the mercury rose rapidly in Texas, in rear of low-area No. VIII. 27th, it extended over the South and Southwest. 28th, moving to the east, the isobar of high barometer circumscribed the Southern States. 29th, the high area occupied the South Atlantic coast. 30th, it disappeared in front of a low area, then developing in Texas.

Areas of Low Barometer.—Eight are described, and all their tracks are charted. The number of storm-areas have been less than the average of December in previous years. Of these, three storms were quite severe; low areas No. I, III, (VI and VII.) Low area No. V appears to have been a secondary development of low area No. IV. Several of the low areas seem to belong to depressions that entered the Pacific coast from the west, but in no case has it been possible to give a reliable charted track of a

depression across the continent. This is in marked contrast with December of 1877, when eight low areas had paths charted over the country, from the Pacific to the Mississippi.

No. I.—is the storm-centre described as No. XIV in the November REVIEW. At the a. m. report of 1st, it was central in western Tennessee. This day, rapidly increasing in energy, the centre moved slowly to the northeast, the pressure at Louisville, Ky., 29.49, being 0.62 below the normal. 2nd, this day the storm-centre moved into the Lower Lake region, and thence into New England. During the forenoon of this day, a special warning was telegraphed to all Middle Atlantic and New England ports. 3rd, pursuing a northeast track, it passed beyond the Gulf of St. Lawrence. It was accompanied in its east and south quadrants on the Atlantic coast by high easterly gales, veering to southerly and thence to westerly, and by heavy precipitation. Cautionary Signals were ordered on the 1st from Jacksonville, Fla., to Eastport, Me., and these were changed on the 2d to Cautionary Off-shore Signals from Macon, N. C., to Cape Henry. The signals were generally justified. The following maximum velocities (measured) are reported: Smithville, 40 SE.; Cape Lookout, 50 SE.; Cape Hatteras, 48 SE.; Kittyhawk, 42 SW.; Cape May, 36 SE.; Atlantic City, 36 SE.; Barnegat, 56 E.; Sandy Hook, 50 SE.; New York, 38 SE.; New Haven, 35 SE.; New London, 69 SE.; Newport, 36 SE.; Wood's Holl, 64 SE.; Boston, 47 SE.; Thatcher's Island, 38 SE.; Portland, 60 SE.; Eastport, 45 SE.

No. II.—2d, appeared first in Manitoba, where the pressure fell 0.7 below the normal. 3d, the centre of depression moved in a southeast track into southern Michigan. 4th, with diminishing energy it marched in an easterly path to Nova Scotia. This storm in the east portions of its track covered much of the country traversed by low area No. I, and rapidly followed it. The precipitation accompanying this depression was light. Rain fell in the advanced quadrants, which changed into snow after the winds veered to colder northwest. Only brisk winds were reported.

No. III.—5th, a great depression entered the North Pacific States. An examination of the Map of departures from the normal pressures shows it crossed the Rocky Mountains on the 6th, but with no well defined centre. 7th, the barometer fell generally from Manitoba to the Gulf, with one centre of depression in Texas, and a second centre in Dakota, both included in the same region of low barometer. 8th, the low area moved slowly to the east, extending from Lake Michigan to the Gulf, the pressure being in this region more than 0.3 below the normal. As this was to prove the severest storm of the month, it is interesting to note the meteorological conditions that existed at the end of this day. A high barometer covered the Rocky Mountain region and its eastern slope, where cold northerly winds prevailed with clear weather; and a second high barometer, occupied the Atlantic coast, where the winds had generally shifted to easterly. The precipitation had in general been heavy, but confined to the region of low pressure. 9th, rapidly increasing in energy, the storm-area moved slowly east, the lowest pressure being from Lake Erie to Georgia. From midnight to the morning of the 10th the storm developed a great increase of energy. The barometer fell in the Middle States, an average of 0.4 inches, and at Norfolk the pressure was 1.02 inches below the normal. At 7:35 a. m., the vortex of the storm was of great extent, nearly covering the States of Pennsylvania, Virginia and North Carolina; in these States the winds were calm, or light and variable, while a fierce southeast gale prevailed on the Middle Atlantic and New England coast. 4.35 p. m., the storm still increasing in energy, the centre occupied the Middle States, where the pressure was generally below 29.00 inches; the following exceedingly low barometers are reported at that hour: Washington, 28.72, 1.40 inches below normal; Baltimore, 28.73, 1.39 below normal; Philadelphia, 28.83, 1.29 below normal; New York, 28.82, 1.23 below normal; while the pressure had rapidly fallen at the centre of the storm in its progress to the east, it had continued to rise slowly at Cape Breton and over the Gulf of St. Lawrence. The rise in that region was as significant as the fall at the centre of the depression in producing the steep barometric gradient existing from New York to Nova Scotia, as shown by the crowded isobars in the weather map of that day. The gradient indicated the fierce gales that accompanied this storm. 11 p. m., the centre of low barometer moved into New York, where the region of pressure of one inch below the mean was of greater extent than at any previous time during this storm, but the rapid fall of mercury in Nova Scotia greatly diminished the barometric gradient on the New England coast and moderated the existing gales. 11th, pursuing a northeasterly track, the storm-centre moved over the mouth of the St. Lawrence river. In the progress of this storm over the country great damage was caused by wind and flood, which will be noted under special appropriate headings. Reports of frequent marine disasters show this storm extended far out to sea on the Atlantic coast. Cautionary Off-shore Signals were ordered on the 8th at Indianola and Galveston, and justified respectively by 42 N. and 40 N. Cautionary Signals were ordered on the morning of the 8th from Cape Lookout to Sandy Hook, and at the morning report of the 9th from Macon N. C., to Key West, also at the midnight report of the 9th from New York to Portland, Me., and a. m. of the 10th at Eastport, Me. These Signals were changed to Cautionary Off-shore from Smithville, N. C., to New York on the 10th and from New Haven to Portland on the 11th. The Cautionary displays were justified by the following maximum velocities, (measured:) Key West, 40, NW.; Savannah, 36, W.; Charleston, 34, SE., 35 W.; Smithville, 48 S., 38 W.; Cape Lookout, 51 S., 64 W.; Cape Hatteras, 64 S., 64 SW.; Kittyhawk, 48 S., 44 SW.; Cape Henry, 36 S., 36 SW.; Cape May, 40 SE., 64 W., Barnegat, 44 S., 43 W.; Sandy Hook, 52 S., 47 W.; New York, 48 SE., 32 NW.; New London, 67 SE., Newport, 38 SE., 36 W.; Woods Holl, 48 SE., 50 W., Thatcher's Island, 44 SE., 41 SW.; Boston, 52 SE., 34 W.; Portland, 60 SE.; Eastport, 44 SE.

Nos. IV and V.—12th, southeast winds, falling barometer, increasing cloudiness, followed by rain on the West Gulf coast gave indication of the approach or formation of a storm centre in Texas. 13th, 7:35

a. m., the veering of winds to northeast in Western Texas indicated the centre shown in the chart. This day the depression moved in a northeast track to western Tennessee and the winds in Texas shifted to high and cold northerly. 14th, the storm-centre moved into the Lake Ontario country. 15th, it disappeared beyond the Gulf of St. Lawrence with ill-defined track. The movement of depression No. IV was quite rapid and the precipitation had been confined in an unusual degree to the centre of the low area. The barometer continued to fall to the east of its charted track, and the rain belt also moved to the east and there was developed a secondary depression, No. V, whose centre is first charted on the morning of the 15th, near Augusta, Ga., though at that time, a region of low barometer extended from New England to Florida. This depression rapidly pursued a northeasterly track, leaving the coast near Cape Henry, moved nearly parallel to the Gulf stream, and is located on the morning of the 16th near Halifax, N. S. The precipitation was general, but not abundant. The high winds reported were of short duration and confined to the Middle Atlantic and North Carolina coast. These storms, taken together are interesting, since the development of the second depression may have been mainly due to the rapidity of the march of the centre of the first low area.

No. (VI and VII).—These two low areas are described together, although they developed in portions of the country far distant, but, as will be seen from their charted tracks the depressions approaching each other were united on the morning of the 21st in the Ohio valley. 17th, there was a general fall in pressure in the Rocky Mountain region, the barometer being most below the normal at Salt Lake. 18th, the low area occupied nearly same position with a slight fall of pressure in Texas. 19th, a decided fall in Texas, where the precipitation and circulation of the winds, showed the formation of a storm-centre. There was a more decided fall of barometer in the Northwest, but a great deficiency in precipitation. 20th, this day the centres of depression marched slowly to the eastward, No. VI moving along the West Gulf coast, and No. VII remaining in Minnesota while there was a marked decline in pressure from the Upper Lakes to the East Gulf. The precipitation in the Gulf States was very abundant, but in the Upper Lakes and the Northwest, although general it was light. 21st, 7:35 a. m., after midnight there was a fall in pressure in the Ohio valley averaging 0.4 inch, and the two low areas became united in a single depression central near Cincinnati, Ohio. 4:35 p. m., the storm centre was over Lake Erie, but southerly gales prevailed on the North Carolina coast, and high southeasterly gales on the Middle Atlantic coast. 11 p. m., New York State was the region of lowest barometer, easterly gales had extended along the New England coast, but on the Middle Atlantic and Carolina coast the wind had shifted to high westerly. 22d, the storm-centre moved along the St. Lawrence valley, and into the Gulf beyond. Cautionary Signals were ordered for this storm, 18th, at Indianola and Galveston, 20th, from Savannah to Kittyhawk, N. C., 21st, from Cape Henry to Eastport; these were changed to Cautionary Off-Shore Signals, 21st from Smithville to Kittyhawk, N. C., and from Baltimore to Wood's Holl, 22d, from Boston to Eastport. The following maximum velocities (measured) are reported: Indianola, 40 N.; Galveston, 30 NW.; Smithville, 36 W.; Wilmington, 43 SW.; Cape Lookout, 44 S.; Cape Hatteras, 48 SW.; Kittyhawk, 40 S.; Cape May, 38 SE., 48 W.; Atlantic City, 36 SE.; Barnegat, 40 SE.; Sandy Hook, 47 SE., 48 W.; New York, 28 SE.; New London, 35 SE.; Wood's Holl, 48 SE., 58 W.; Thatcher's Island, 36 SE., 36 W.; Boston, 40 E., 35 W.; Portland, 44 E., 32 W.; Eastport, 40 SE.

No. VIII.—24th, the barometer was high and rising in the Southwest, and a severe "norther" with cold rain or sleet prevailed on the West Gulf coast. 25th, the pressure slowly diminished in the Gulf States, and the circulation of the winds in the Gulf marked the development of a storm centre. 26th, 7:35 a. m., the centre of depression was situated southwest of New Orleans. This day the storm-centre moved, with great rapidity, to the northeast as charted. 27th, 7:35 a. m., it passed beyond the limits of the map. It was accompanied by general but light precipitation in the Gulf and South Atlantic States. The winds were high and from the north on the Texas coast elsewhere were only brisk.

INTERNATIONAL METEOROLOGY.

On chart No. IV are shown the probable tracks of storm-centres over the oceans, as follows: *Atlantic*.—No. I, as previously given; No. II is the extended track of area No. IV, given under International Meteorology in the November REVIEW. No. III is the extended track of area No. IV of the October REVIEW; No. IV is the extended track of area No. VI, given under International Meteorology in the November REVIEW, and which probably joined the following area; No. V is the extended track of area No. IX, October REVIEW; No. VI is the extended track of No. VII, given under International Meteorology in the November REVIEW; No. VII is the extended track of area No. III of the November REVIEW. *Caribbean Sea*.—November 24th and 28th, a violent hurricane reported south of St. Thomas, W. I.; at midnight of December 1st, the schooner Thos. Pickering was reported driven ashore by hurricane on reef 35 miles NNE. of Saona Island, near St. Domingo. December 1st and 2nd heavy E. and SE. squalls at Navassa. At Colon, Panama, a severe "norther" commenced on morning of the 4th and continued until the 10th, accompanied by heavy rains and floods; at 7 p. m. of the 10th, a second "norther" commenced, lasting until the 14th; much damage resulted from these storms. *Pacific*.—No. I, W. to NW. "typhoon;" No. II, November 15th to 19th; No. III, November 22nd and 23rd, hurricane, barometer 28.18; No. IV, November 28th and 29th; No. V, December 3rd to 6th. *Indian Ocean*.—Mauritius, "during a barometric depression which passed over this island, between September 28th and October 8th, severe gales occurred in 36° to 44° S. and 20° to 42° E.; the wind at Mauritius veered from SE. to E., NE., &c., round the compass."